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Company Life History Analysis and Technogenesis: A Spatial View

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Abstract

This paper examines the relationship between innovation dynamics in individual companies and the urban environment. First, this theme is discussed theoretically, while an overview is given of major new insights in this field. Secondly, company history analysis is presented as a useful method for an empirical investigation of the long term renewal of firms in a spatial context. Next, based on pilot studies a set of important data and validity problems is discussed and empirically analyzed on the basis of a small sample. These studies show that companies may follow distinct development paths within a challenge-response framework, e.g. incremental renewal or shockwise readjustment. Also, the pilot studies point at the influence of the urban environment on the renewal of firms.



1. Introduction

The issue of (technological) innovation has received a great deal of attention in recent economic literature. Inspired by (neo)-Schumpeterian and (neo-)Fordist thought, the motives for and the impacts of innovation in an era of economic stagnation and restructuring have been thoroughly analysed, both theoretically and empirically. In addition to macro- and meso-economic analysis, micro-approaches to entrepreneurial behaviour have been gaining in importance. In this context, product-life cycle phenomena, oligopolistic market behaviour, corporate strategies from industrial economics and institutional economic paradigms have all become focal points of recent economic research.

The spatial (urban and regional) picture of innovation has also been analysed quite thoroughly in recent years. Space not only acts as a dimension upon which the dynamic processes are projected (e.g., in terms of relocation behaviour), but it also provides the medium through which economic dynamics are generated and transferred. Spatial economic structure appears to provide the vehicle for the generation and adoption of innovations, not only in the industrial sector but also in the service sector, especially in the increasingly important producer services. Also the spatial and socio-economic networks behind new technology become the driving force for the evolution of individual firms.

In general, the history of a firm and the trajectory of its technology are closely interwoven. An increasing interest in economic restructuring and innovation has developed in recent years as nations have sought mechanisms to emerge from economic recession. Following the arguments of Schumpeter, most economists now share the view that industrial innovation is an essential condition for the upswing phase in a long term Kondratieff cycle; as well as an accelerating force in emergence from medium term down turns.

In this paper we adopt the convention that an innovation may be interpreted as the design, construction and successful introduction of new (or improved) commodities, services, production processes, managerial and organisational structures, or distribution processes. We are particularly interested in innovations introduced at those points in time or stages of the history of a company which lead to a significant shift ("jump") in the performance of a firm. In general, innovation is distinguished from invention by commercial implementation in the market place. In particular, the focal points of this paper are the changing

significance of different urban environments for the advancement of technological change and the relationship between this change and the evolution of corporate organisations.

In recent studies much attention has been devoted to those conditions which are favourable to the innovation process: the knowledge intensity in the firm, communication networks, market forms, capital intensity, accessibility to suppliers and to markets, organisational structures and so forth. The blend of all these conditions is sometimes referred to as technogenesis (see Kamann and Nijkamp, 1990). Innovations do not appear as 'manna from heaven', but they are the result of entrepreneurial strategies (see among others Freeman et al., 1982; Kleinknecht, 1987; Nelson and Winter, 1982; OECD, 1982; Rothwell and Zegveld, 1981; and Thwaites, 1978).

The conditions for technogenesis are unequally dispersed over space: patterns of innovation exhibit a clear geographic component, not only because of sectoral variation among firms in different areas, but also because of differences in locational requirements and in spatially discriminating urban and regional policies (e.g. an urban incubation policy, or a regional technopolis policy). Consequently, in the recent past many attempts have been made to analyse the geographic aspects of innovative behaviour (for example, Ewers and Wettmann, 1980; Goddard, 1981; Bruder, 1983; Gillespie, 1983; Malecki, 1983; Keeble and Wever, 1986; Nijkamp, 1986; Giaoutzi et al., 1988; Orishimo et al., 1988).

The city is the cradle of many new commercial ideas, but only a few of them have evident market success. Besides, there is in general a spatially unequal rate of failure, so that the net fertility in creating successful ideas is a crucial matter of urban competitiveness and sustainability. In this context, one should consider not only the number of newly established firms, but also their - probably spatially unequal - chances of survival in the first few years. With a high net success rate, the city is said to have a high seedbed or incubator function (see Davelaar, 1989). The example of Route 128 on the edge of the Greater Boston Metropolitan Area provides a good demonstration of the importance of geography in the innovation process.

However, in looking at the production milieu (or what may be termed the selection environment) of the spatial pattern of innovations, the dynamics of the processes involved too often have been overlooked. Unfortunately, static (or comparative static) analyses have dominated. Very few studies have considered the long term evolution of firms empirically, particularly from the perspective of innovative behaviour

related to restructuring. This paper is focussed on the issue of the dynamics of these strategies toward innovation which operate within individual firms.

2. Economic Dynamics and Innovation: A Microscopic View

2.1 Theoretical notes

It is a widely held belief that there are distinct structural adjustment periods in any given economy. Old industries and markets may disappear, whilst new industries and markets may come into being. The revival of Schumpeterian views on economic dynamics can be understood in this context, since one of the basic postulates of this writing is that innovations generate economic progress. Innovative firms have to find new niches in the market in order to cope successfully with the saturated markets for existing products. Thus both price competition (for existing products) and product competition (for new niches) may be meaningful strategies for the Schumpeterian firm. Innovation gives the firm a competitive advantage, which will then have to be defended (cf. Ayres, 1987, Rothwell and Zegveld, 1985).

In this framework, product innovations may be seen as relevant for conquering new markets (or niches), whilst process innovations result in productivity and price advantages. In the literature two types of Schumpeterian models are distinguished (see Freeman et al, 1982; Winter, 1984). The first one is based on the concept of 'creative destruction' as a result of a permanent search by firms for new combinations of products and organisational arrangements, induced by scientific research. However, the benefits of a competitive advantage will soon be levelled off, as other firms enter the market through imitations or improvements of these new combinations. This leads to the so-called swarming process. The second Schumpeterian model assumes that technology is an endogenous part of the economic mechanism. Additional profits generate more R&D, leading to innovation and hence to competitive advantage. On the other hand, losses may also lead to innovative behaviour in order for the firm to survive (the 'depression-trigger' hypothesis).

In addition to (neo-)Schumpeterian analyses of the dynamics of firms there have also been advances in other branches of economics which have a direct bearing upon the framework of analysis for spatial industrial evolution. Especially in the area of industrial economics a greater understanding has been achieved of the processes of invention and innovation and of the patterns of diffusion of new technology within

the firm and across industrial sectors. Reviews of this field of research can be found for example in Stoneman (1983) and Coombs et al. (1987). In addition, greater insight has been reached into the impact of technological change on national economies, and this has allowed more penetrating analyses of technology policy (cf. Stoneman, 1987).

At the same time advances in economic theory of the firm have moved the focus of empirical work. These advances are using game theory as well as standard equilibrium analysis and dynamic simulation, drawing especially upon the 'markets and hierarchies' (or 'new-institutional') work of Williamson (1985) and others. A particular focus has been on the behaviour of firms in oligopolistic market structures. These lines of thinking have been profitably applied to the strategies of multinational corporations (Buckley and Casson, 1985), as well as to issues of technology transfer, economies of scope, quality control, divestment and integration within companies (Casson, 1987; Clarke and McGuinness, 1987; Scott and Storper, 1986). Technical change issues include diffusion, appropriability, the impact of uncertainty, imitation and the economics of patents and the general influence of different market forms. The core of this recent work, transaction cost theory, comes from the mainstream of economic theorising on the working of markets, and provides a fertile base for further work on innovation in companies and interactions with the urban environment.

A key factor in the orientation of the firm towards innovation seems to be the changed organisational form of the firm. During the late sixties and early seventies there was a strong tendency towards mergers and an increase in scale of production within one firm. By the nineteen eighties this process was followed by a tendency to focus in on core activities with a concomitant flexible production organisation, with the introduction of co-makers, sub-contractors etc. These tendencies have changed the position of the firm and its orientation towards innovation, offering for instance the rise of the low innovative branch plant (Taylor, 1983) and subsequently the rise of the low innovative firm in the secondary segment of the dual production organisation (see Piori and Sabel, 1984).

Important events in the history of a firm involve changes in vertical integration, and/or horizontal integration, or disintegration in one or both of these. An example of drastic change is the shift between the major functional areas, e.g. the elimination of manufacturing in favour of marketing and service. Other changes in the scope of the firm would include events in either the product or process technology, or in both.

Young companies may change from a monoprocess to a multiprocess context, or from a monoprocess to a multiprocess context. Events in the life of older, diversified firms may only involve shifts within a multiprocess and multiprocess context.

Clearly, one may next also introduce all the various spatial possibilities of the location(s) of the firm and of its linkages - e.g., monoregion, multiregion, monourban, multiurban-monoregion - into this framework. This would also include an explicit consideration of the firm's spatial context.

From recent cross-sectional studies at the micro level (e.g., Malecki 1983) it appears that the (relative) location or orientation to the urban core region has diminished in importance as an explanatory factor for differences in innovation activity. Manufacturing firms located in large urban areas do not exhibit a larger degree of innovativeness than firms located elsewhere. This raises questions about changes in growth strategy and the spatial requirements to survive successfully in different urban environments.

Despite many advances in innovation research, various research issues remain to be uncovered or resolved. One missing link is the two sided relationship between the dynamics of individual firms (or specific branches of a given industry) and the growth pattern of their host city. Both theory and related empirical research are under-developed. There is a need for a more behaviourally oriented perspective on both urban and industrial dynamics, supported by empirical evidence.

There is also a need for a more solid prospectively-oriented modelling effort so as to generate plausible trends and scenarios based on empirical economic research. Thus, although economics has made progress in analysing urban-industrial dynamics in relation to innovations, various opportunities are now emerging for a significant advance in understanding.

2.2 A new research area

In this context the concept of company life history analysis may provide new analytical insights into spatial industrial dynamics (see Van der Knaap and Van Geenhuizen, 1988). Company life history analysis aims at identifying the key forces in the rise and decline of firms, particularly regarding strategic decisions on new investments, significant expansions, exploration of new markets, production of new commodities, adoption of new technology processes and new management styles. The research method is usually a longitudinal, retrospective and

comprehensive analysis at the level of the individual firm, making use of content analysis of annual reports (or other written documents) and in-depth interviews with corporate managers. In this way the method yields data on relevant indicators in time series which enable the testing of hypotheses concerning cyclical or wave-like patterns of growth at the micro level. In the context of spatial industrial dynamics, company life history analysis may provide answers to such questions as:

- what is the interaction between the history of individual companies over past decades, their innovative behaviour and the evolution of local urban areas (with an emphasis on exploratory and explanatory longitudinal study)?
- what are the empirical difficulties which have to be faced in a longitudinal analysis of an individual company life history (with an emphasis on an operational analysis and a research framework)?

Thus one of the main themes of company history analysis is to identify the role of urban environments in technological change and the ongoing renewal of firms.

From a methodological viewpoint two research strategies for investigating the company-city relation can be distinguished. The first strategy focuses on contrasts in urban environments, e.g. in terms of sectorally diversified or specialized development. A meaningful analysis can then be found by comparing the history of fairly homogeneous companies within contrasting urban development patterns. A second (and additional) approach is by identifying the actual influences of the urban environment by means of an in-depth analysis. This analysis should then focus on both propulsive and constraining factors experienced by the company.

The previous observations suggest that the principal research objectives of spatial company history analysis are:

- to develop theory, research methodology and empirical understanding at the interface of new technology, company growth and urban economic development;
- to develop an historical approach to relate growth patterns of companies (rise and decline) to their locational characteristics;
- to use a longitudinal analysis to relate the adoption or generation of innovations in companies to their locational characteristics;

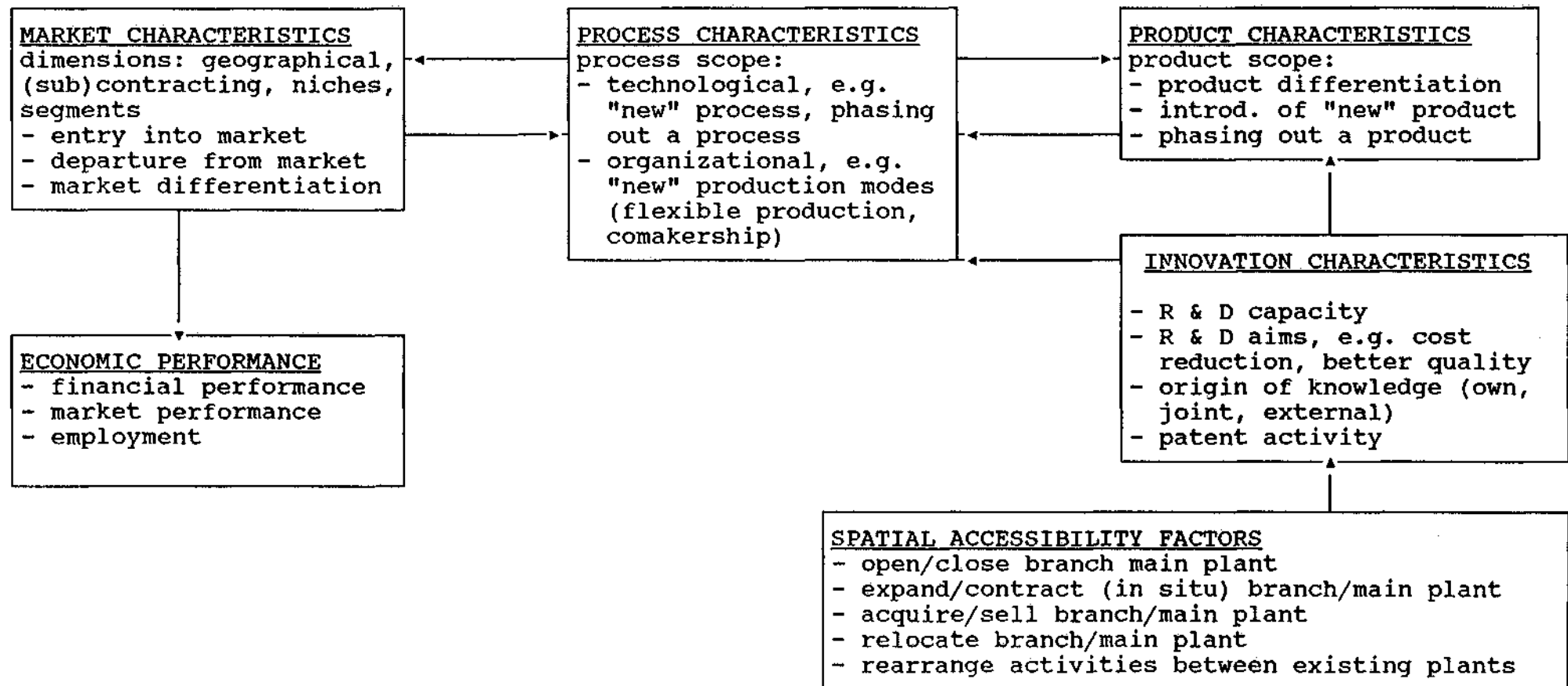


Figure 1. An overview of elements in company history analysis.

- to identify the spatial components in the main differentiating forces in the growth and innovation of companies.

A synthetic overview of the various elements to be considered in spatial company history analysis can be found in Figure 1. This overview focuses on manufacturing firms and excludes shifts from manufacturing towards marketing and service, for the sake of simplicity.

It should be noted that within the technology-to-firm relationship two different processes can be distinguished, viz. the establishment of new firms based on the new technology, and the introduction of this technology by existing firms. A further important distinction should be made between the generation of new technology within the firm and the adoption of new technology by the firm. A reasonable time span for the longitudinal research may then be one or two generations, although in practice a time horizon of more than 35 years is almost infeasible due to poor records etc. The choice of the sector for the research could be open: any sector exhibiting significant developments in the technology of either product or process over the time period under review. This criterion would encompass just about all sectors. The field may be narrowed however by considering those sectors normally associated with the fourth Kondratieff wave (petrochemicals, synthetic materials, electronics) and the fifth Kondratieff wave (new materials, biotechnology) (see Drewe, 1987, Kleinknecht, 1987, and van der Knaap and Linge, 1989). However, the link between these new products or technologies and sectors is not always clear. For instance, the application of modern biotechnology is very broad, viz. in pharmaceuticals, specialty chemicals, health care products, the food industry, and plant or seed production and protection (Daly, 1985).

A possible complementary approach is to focus on the role of firms in the long wave, in seeking out the "first innovators" in the sector located in different urban environments (whether or not they end up being the commercial winner). In relation to the fifth Kondratieff wave most relevant firms are likely to be still alive. However, some firms related to the fourth Kondratieff may have been completely merged or they may have closed down. The firms that failed are of special interest, but data are often scarce or in-accessible.

An alternative strategy is to identify traditional and modern sectors which display a relevant difference in spatial concentration. The choice of firms within the sector can be based on this difference, in

relation to the level of urbanisation. This approach focuses in particular upon spatial dispersion and on the impact of agglomeration economies.

A final alternative focuses on different patterns of urban economic evolution. The choice of cities to be studied will be guided by the development patterns that have been followed in urban economic growth. For example, a sectorally specialised development pattern may be compared with a diversified development pattern or a pattern involving sudden shifts in the specialisation or role of the city in the spatial division of sectoral activity.

2.3 Challenge-response model

Technological progress may be regarded as an opportunity for the firm, because the firm can strengthen its competitive position by adopting innovations. It is hypothesized here that the firm can react in two different ways: an active response in which the firm can keep pace with the technology or market changes, and a passive response.

If one would adopt a challenge/threat-response model of a firm, one may construct a success-failure development path matrix. Clearly, the extent to which the firm can respond effectively depends on the availability of information concerning the threats and opportunities and on the characteristics of the firm, such as age or life cycles and organisational characteristics (see Table 1).

	Gradual changes (challenge/threat)	Radical changes (challenge/threat)
Active response	Success (incremental development)	Success (fundamental readjustment)
Passive response	Success or Failure (fundamental readjustment necessary after certain time of passive response)	Failure

Table 1. A challenge - response model for firm behaviour.

3. Experiences with Company Life History Analysis

3.1 General experiences

Clearly, in the field of economic history much research work has been devoted to descriptions of the evolution of given products, of given firms or of sectors as a whole. However, in general these studies have not explicitly focused on spatially discriminating or spatially decisive factors in the economic development of firms. Elements such as the structure of production, changes in market position and in market strategies, shifts in product specialisation and differentiation and the impacts of emerging external conditions have not usually been explicitly analysed against the geographical setting of firms. Only a few studies have been conducted in which the strategic decisions of firms were related to the locational interests of a firm from a longitudinal perspective (cf. Krumme and Hayter, 1975; Glasmeier, 1987).

An interesting example from the Netherlands of a longitudinal study on the growth of firms can be found in Van der Knaap and Van Geenhuizen (1988). In their retrospective analysis, with a time horizon of almost 35 years, annual reports (if available) and in-depth interviews have been combined as data sources. In many cases it appears possible to reconstruct the life history of the individual firms although biases caused by memory gaps can never be completely avoided. To catch as much variety as possible, the selection of companies in this research was based on differences in size, in the number of products and plants, the sector (traditional, modern) and on major strategic changes in recent years. On average, the analysis of annual reports took approximately four working days, with one outlier taking twice as long (a complex multi-product and multi-plant company). In most cases a structured interview schedule has been used, and in general managers with a long working career with the firm have been interviewed. The interviews lasted approximately two hours. In the case of complex firms two such interviews were necessary, with different managers.

In the framework of this company history analysis, the following themes have been explored:

- a. economic performance;
- b. growth and innovation strategy;
- c. patterns of growth (internal, external) and resulting spatial organisation;
- d. background of strategic changes (position of firm, dynamics of the market);

e. influence of the urban environment.

With each of the above themes, a set of interesting data availability and validity problems emerged from the Dutch study, which will now briefly be discussed.

3.2 Data availability and validity

Economic performance

Financial performance indicators, like turnover, profits and cash flow, are generally available in annual reports. However, in some cases there are problems of comparison between time series, due to changes in methods of accounting. If there is no annual report, figures concerning the past are generally not available, or may be only roughly estimated. An attempt at finding exact figures by interviews is time consuming and causes resistance from the side of the interviewee.

Figures concerning market position are mostly available for recent years. While figures for the past do exist in written documents, it is time consuming to collect these, due to the spread of information within the firm. Hence, for practical reasons, missing figures concerning the past may sometimes have to be estimated by corporate experts. This estimation may of course suffer from gaps in the memories of individuals.

Growth and innovation strategy

Data concerning growth strategies with regard to functions, products and markets are generally available for the whole observation period. However, data concerning process characteristics seem to be less available. In general, the level of detail and accuracy is lower for the 1950's than for later years.

In the planning of interviews, the theme of growth was found to need precise definitions for different possible strategies, such as product differentiation and diversification, in order to guarantee comparability of the firms. As it is impossible to analyse all the changes in the growth of a firm, a selection has to be made. A possible approach is to include only the most important changes - incremental as well as fundamental - within a challenge-response framework. The "threshold value" of importance may be determined by an expert from the firm.

In general, measuring the level or intensity of technological innovation is restricted by the absence of valid indicators. Identifying and counting innovations is inaccurate due to different levels of novelty and interrelations between innovations. In addition, input-indicators such as the number of R&D workers and the amount of R&D

budget, suffer from a lack of uniform definition. Hence, these figures have to be interpreted carefully.

The availability of R&D figures differs in Dutch companies. Some annual reports offer a time series from 1970 until now, but others only for the last few years. Hence, in this study figures concerning innovation activity depend heavily on estimation by corporate experts. In addition it should be noted that R&D figures ignore the existence of 'informal' R&D. Small firms, without a R&D department and a R&D budget, may have continuous innovation, incorporated in their production.

Patent figures suffer from the same type of drawbacks as R&D figures (see Kamien and Schwarz, 1982). From the viewpoint of a retrospective analysis it is a major advantage if patent applications and rewards are noted in company records or in a national patent office. However, in spatial analyses patent figures should be interpreted carefully in the case of mother and daughter companies, as the mother may apply for patents whereas the R&D is carried out in the daughter in another city or region.

In addition to a quantitative approach, an innovation strategy of a firm can be assessed qualitatively, with regard to the aims and the character of the innovation. In general the research experience using this approach in Holland was satisfactory, although for the 1950's and 1960's some bias was caused by gaps in memory.

Patterns of growth and spatial organization

Growth may be realised within the company (internal growth) or on the basis of other companies (external growth). As a result of growth events, such as the establishment of a branch plant or take over, the spatial organization of the company may change and concomittant with this, the accessibility of different urban milieus may change. Data concerning growth events are generally available. However, some companies are extremely active in joint research or production and in these cases the data are usually not complete. Thus, data collection regarding joint development over time - aims, type of relations, location of partners - usually requires additional interviews.

Background of strategic change

The background to major changes in the growth and innovation of firms includes influences such as market dynamics and technology. Data concerning the character of these influences and their intensity - gradual or radical - are generally available in annual reports in broad

lines. Also, these themes can be easily discussed in the interview, although some bias may be caused by personal interpretation of the interviewee. In case of doubt, external information sources may be used, like newspapers and branch societies.

Influence of urban environment

Data concerning promoting or constraining factors can only be derived from interviews. The questions concerning these factors should be very specific, e.g. referring to infrastructure or to labour market characteristics, because the interviewee is not used to thinking in general spatial terms.

3.3 Some empirical results

Different types of renewal

In our study the histories of three different Dutch firms will be presented here (Tables 2 through 4), as they properly illustrate different types of processes of renewal (Van der Knaap & Van Geenhuizen, 1988; Van Geenhuizen, 1989). The firms are Nedap, Van Besouw and ACF. In terms of the challenge-response model, Nedap can be regarded as actively responding to technological challenges and as a result was commercially successful (see Figure 2). The development of Van Besouw is characterised by passive response over several years. This was followed by a short period of substantial restructuring and recent commercial success. Both companies increased their R&D intensity. ACF (or Nedchem), in contrast, was innovative during the 1950's and 1960's, but decreased its R&D budget in the late 1970's.

By focusing the analysis on products and markets, it becomes clear that Nedap introduced four major innovations: a new product in 1957, a new market in 1962, a significant product improvement around 1972 and again a new product in 1975 (see Table 2). This meant a stepwise change from mechanical and electro-technical products towards electronics and partly a shift towards customized production. At the time of the introduction of new products the market had usually not yet been identified.

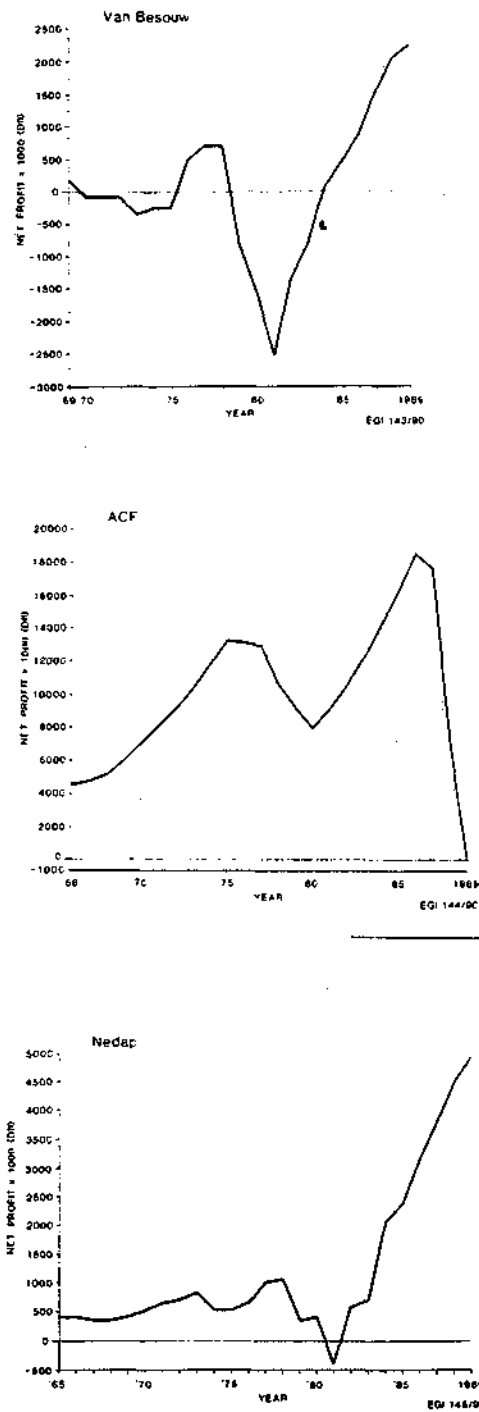


Figure 2. Net profits (three years average)

Source: Annual Report

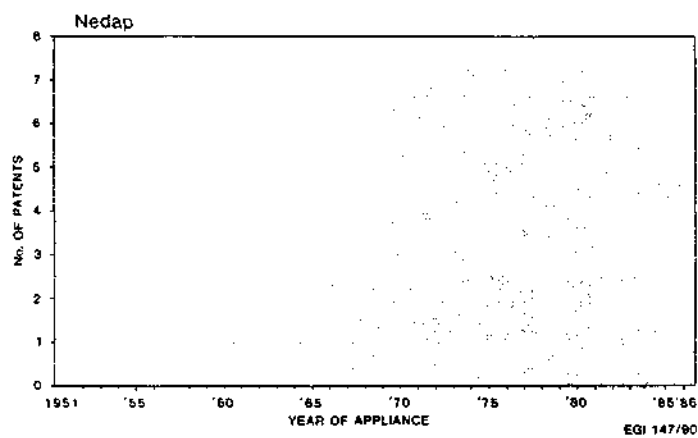
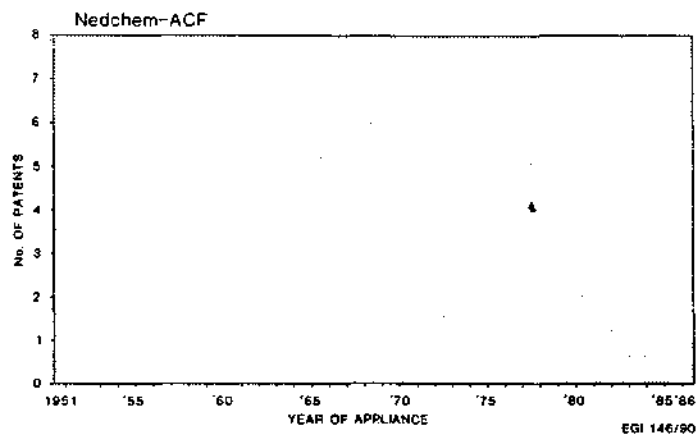


Figure 3. Number of patents rewarded.

Source: Dutch Patent Office

Also Van Besouw experienced major innovations with regard to products and markets (Table 3). This resulted in a reorientation from mass produced carpets and traditional textile fabrics towards high standard carpets and synthetic products for specific market segments. In 1968 the management chose to raise the quality standard of the products. The resulting success during the seventies was based on the introduction of a 'fashionable' new carpet in 1972. However, during the seventies the management was less alert regarding imitation by competitors and the opportunities offered by synthetic products. This resulted in a crisis during the early 1980's. After a substantial readjustment of the company, profitability increased (see Figure 2) and nowadays turnover in synthetic products exceeds that of carpets.

The post-war history of ACF (Table 4) is first dominated by success resulting from the innovative character of the company in the area of chemical-pharmaceutical intermediate products and of pharmaceutical final products. During the 1950's and 1960's 30 patents were granted (see Figure 3). The turning point came in the late 1970's, when the revenues from licences and from profits from intermediate products were decreasing. Two major decisions were taken, the first diminishing R&D budgets and the second growing the firm by acquisition. After some years the last decision resulted in a broad diversification, and the original core-activity became of minor importance. A crisis started when a new acquisition (consumer-electronics) turned out to generate losses (see Figure 2). Nowadays the company is in a process of fundamental readjustment.

An evaluation of these three histories in terms of responses to technological opportunities, reveals that internal (within the company) and external factors may be very different. Nedap produces in a branch where many new technologies are involved. In addition, the company has been managed by forward-looking staff for many years. Thus, investments in new products were made at a time when the old products were still making profits. In the case of Van Besouw, the textile branch offered less technological opportunities and the company moved partly towards another branch. This shift took place rather late, due to a focus of the management on ongoing commercial success and social structures within the company. After the readjustment in the early 1980's the company is more actively responding to opportunities. In 1987 a laboratory has been opened for research on synthetic products.

The chemical-pharmaceutical branch is characterised by many technological opportunities, although there seem to be less basic inventions

these days than in earlier periods. The main motives of ACF for decreasing R&D intensity were the high costs and high risks of basic research in relation to the relatively small size of the company. Following this policy, ACF acquired access to some new technologies such as diagnostics and bio-implants, in cooperation with other companies. In addition, the remaining R&D was focused on the original specialization of quinine derivatives and antimalaria drugs. But finally it seems that the strategy of broad diversification prevented the company from responding effectively to technological opportunities.

Urban environment and renewal

In evaluating possible influences of the urban environment on the process of renewal in these companies, a distinction between the different development paths seems to be important. Nedap, as an example of stepwise successful renewal, experienced no strong positive or negative influences from the urban environment. Its reorientation during the 1970's was only stimulated initially by contacts with the Technical University of Enschede (at a distance of approximately 20 miles) and by recruiting the first engineers from this University. But the successful reorientation originated mainly from within the company. Presently research contacts of Nedap are world-wide. However, from another study in the Netherlands (Vaessen, 1989) it appears that companies experiencing a shockwise readjustment or persistent failure, may rely heavily on regional development agencies for the provision of investment capital and management. In these cases the contribution of the spatial environment is critical.

Focusing on the type and strength of spatial influences, the distinction between service and production companies turns out to be important (Vaessen, 1989). For service companies, the positive spatial influences are stronger both at the supply side (capital, employees) and the demand side (major clients). For production companies the influence of the spatial environment is mainly at the supply side.

Thus, empirical research indeed points to different spatial influences on the growth and renewal of firms. Some of these influences may be of critical importance for the company, others may be of minor importance. This issue of different **levels** of importance is a basic element in spatial company history analysis. Another issue concerns the self-organizing capability of companies in relation to the urban environment. Some companies simply overcome shortages (e.g., in terms of inputs) by solving the problems in a creative way. For instance, in the early 1960's Nedap suffered from a shortage of skilled labour, but the company solved this problem by in-house training.

4. Conclusions

At the intersection of spatial and temporal dispersions of innovation, some research issues remain to be uncovered, focusing on individual firms. An important issue is the dynamics of incubation and the conditions favourable to innovation (technogenesis). These include the establishment of new firms using new technologies, as well as the generation of new technologies within existing firms and the process of adoption. Within this framework spatial company history analysis provides new analytical insights into the spatial differentiating factors in the rise and decline of individual firms, particularly regarding significant expansion and contraction, new products, new technology and organizational processes, and new markets.

The method of company life history analysis proposed in this paper is a longitudinal, retrospective and comprehensive analysis, based on content-analysis of written documents (annual reports) and in-depth interviews with corporate managers. The method yields data in time-series which enable the testing of hypotheses concerning cyclical or wave-like patterns of growth at the micro level. With company life history analysis, development trajectories of individual firms may be traced from different viewpoints, e.g. smooth development or irregular patterns, successful adjustment patterns or failure.

From pilot studies of individual companies it appears that the spatial environment indeed contributes to growth and renewal. But the level of importance of these spatial influences needs more clarification. The same holds for the self-organizing capability of companies in relation to shortages in the spatial environment. Clearly, a further development of spatial company life history analysis will open up a rich research area.

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Table 2. Major changes in the history of Nedap*

Year(s)	Products and markets
1950's	- Production of synthetic (bakelite) intermediate products and electrotechnical equipment (low voltage installation, transformers)
1957	- Introduction of a new product (mechanical switchers, switch boards)
1962	- Entry into market of customized production (sub-contracting)
1965-1970	- Elimination of traditional products (low voltage, bakelite products)
1972	- Product improvement (ic's)
1975	- Introduction of a new product (detection systems)
1980 - now	- Product and market differentiation (new applications of detection systems)

* Established in 1929; present location in small settlement in the non-urbanised Eastern part of the Netherlands.

Table 3. Major changes in the history of Van Besouw*

Year(s)	Products and markets
1950's	- Production of carpets and technical fabrics (cotton, jute)
1965	- Product improvement (synthetic and coated fabrics)
1968	- Entry into new market segments and changing market strategies (carpets)
1970	- Introduction of a new product (extruded plastic sheets)
1972	- Product improvement (cotton carpet)
1978 - now	- Product and market differentiation (new types of extruded sheets/films)
1981-1985	- Restructuring: a. elimination of traditional fabrics b. stronger emphasis upon products with higher added value (carpets and extruded sheets/films)
1987	- Product improvement (fleece-based carpets)

* Established in 1836; present location in suburban area of medium-sized city of Tilburg (medium-urbanised South of the Netherlands).

Table 4. Major changes in the history of AFC (Nedchem)*

Year(s)	Products and markets
1950's	- Production of chemical intermediates (based on quinine, sulfanomides) and pharmaceutical final products; wholesale activities
from 1962	- Introduction of raw materials (vertical backward integration by establishment of plantations)
1971/72	- Introduction of wound dressing products (by acquisition) and cosmetics
1978	- Introduction of technical products (coal brushes, graphite products for electrotechnical and metallurgic industry; by acquisition)
1986	- Elimination of traditional product (sulfanomides)
1986-1988	- Focus on core activities: health care and limited number of technical products (manufacturing and wholesale)
1987	- Introduction of consumer electronics (acquisition of trade company)
1989	- Strong focus on health care products : elimination of technical products and consumer electronics

* Established in 1881 (oldest ancestor company); present location in suburban area between Utrecht and Amsterdam (highly urbanised Western part of the Netherlands).